



A new Chrysomelid-Pinaceae relationship: *Calomicrus foveolatus* (Coleoptera, Chrysomelidae) feeding on the Andalusian fir, *Abies pinsapo* (Pinaceae) in the Sierra de las Nieves National Park (Málaga, Spain)

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Abstract

Aim of study: A defoliating insect, *Calomicrus foveolatus*, feeding on the Andalusian endemic fir *Abies pinsapo* (Pinaceae) is herein reported for the first time. Until now, this chrysomelid beetle was known to feed exclusively on *Quercus* spp. (Fagaceae).

Area of study: The study was carried out in the forests of *A. pinsapo*, restricted to protected mountainous areas of western Málaga and eastern Cádiz in southern Spain.

Material and methods: Since 2001 we carried out monitoring for potentially damaging insects at five sites of the pinsapo forests at least once a year. The monitoring visits were increased to 2-3 times a year at the sites that contained the phytophagous species.

Main results: *Calomicrus foveolatus* was observed feeding on pinsapo needles in sites of Sierra de las Nieves National Park, in Málaga province. Besides, damaged pinsapos were also observed in Sierra de Grazalema Natural Park in Cádiz Province. Feeding activity consisted of partial and superficial damage from gnawing on the upper side of the needles; eventually producing death of the needles and finally death of the entire shoot. The recognition characteristics of the beetle and its injury on the needles and branches are described.

Research highlights: It is described, for the first time, the attack of a phytophagous leaf beetle, *C. foveolatus*, to the endemic conifer *A. pinsapo*, in the National Park “Sierra de las Nieves” in the province of Málaga, Spain. Further monitoring of this beetle is necessary for the sustainable management of this protected fir endemic to the Baetic regions.

Additional keywords: beetle; Galerucinae; phytophagous; conifer; gymnosperm; forest.

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Introduction

During periodic fauna monitoring surveys in the *Abies pinsapo* (commonly known as pinsapos) forests in the Ronda mountains, signs of dryness on the branches, stems and leaves of several pinsapo trees were found. After close examination, feeding injuries on the fir needles were evi-

dent. The damage had been made by phytophagous beetles of the family Chrysomelidae, generally called leaf beetles, which were found moving and mating among the needles. Chrysomelids are phytophagous beetles that feed on roots, stems, leaves and flowers (Jolivet, 1987).

Abies pinsapo Boissier is a conifer which is endemic to the mountains of south-western Spain. It occupies some

1250 ha on the north and north-western slopes in the Natural Parks of Sierra de Grazalema (Cádiz), Sierra Bermeja and Sierra de las Nieves National Park (Málaga). Its range is from 1000 to 1800 m above sea level. The height of this species can reach up to 30 meters. Another fir species in northern Morocco, *Abies maroccana*, is considered to be a subspecies of the nominotypical species (Amaral Franco, 1986; Herrera et al., 2001).

The Andalusian fir trees represent an exceptional case of a temperate forest in a Mediterranean climate (Arista, 1995; Navarro Cerrillo et al., 2006). This Spanish fir is currently in danger of extinction. Among the threat factors is habitat fragmentation, genetic homogenization, and global and climate change. The Andalusian fir forms monospecific woodlands or forests mixed with *Quercus rotundifolia* and *Q. faginea*, on calcareous or serpentine soils (Amaral Franco, 1986). An in-depth description about the pinsapo species and woodlands is found in López-Quintanilla (2013).

In this paper we report the first identified defoliating agent of *A. pinsapo* needles, which belongs to the phytophagous family Chrysomelidae, give its recognition characteristics and describe the injury that produces on the needles and branches.

Material and methods

The study took place in the Sierra de Grazalema Natural Park (Cádiz), Sierra Bermeja Natural Park and Sierra de las Nieves National Park (Málaga), in Andalucía, southern Spain (Fig. 1).

Sampling was carried out at least once per year from 2001 to 2022. The sites wherein the injuring beetles were detected were monitored 2-3 per year, amounting to 40 visits in total.

Body length of the beetles was measured with the ocular grid of a Nikon SMZ-10 stereoscopic microscope at a magnification of 10X. Photographs of the habitus and genitalia were taken with a Leica S9I stereo microscope and a Canon EOS 550D photographic camera attached to a Nikon Alphaphot-2 YS2 microscope, respectively. Zerene Stacker® was used for stacking the photographs. Photographs of live beetles and trees were taken with a Fujifilm FinePix HS10.

The beetles were identified using the keys provided by Laboissière (1912), Warchałowski (2010) and Vela (2018).

Results and discussion

The phytophagous beetles injuring pinsapo needles were identified as *Calomicrus foveolatus* Rosenhauer, 1856, a beetle of the Chrysomelidae in the subfamily Galerucinae, tribe Luperini. Among Iberian fauna there are five species belonging to the *Calomicrus* genus: *C. circumfusus* (Marshall, 1802), *C. suturalis* (Joannis, 1865), *C. sordidus* (Kiesenwetter, 1873), *C. ibericus* Vela, 2008, and

C. foveolatus (see Vela, 2018); of these, the last three are endemic to the Iberian Peninsula. Moreover, *C. foveolatus* was formerly found in the Granada and Málaga provinces, while *C. sordidus* was recorded in Jaén, Málaga and Cádiz. Thus, these two species are endemic to Andalusia (Vela & Bastazo, 1999; Vela, 2018).

A short description of *C. foveolatus* and data on the damage are given below.

Habitus. Medium sized beetle, of 2.67-3.29 mm (males, n=10) and 3.27-3.90 mm (females, n=10). Black teguments (Fig. 2a). Legs, antennae, mandibles, base of the labrum and palps yellow. Antennae and mandibles darker at the apex, with a brownish hue. Tarsomeres III and IV usually brownish. Base of metatarsomere I with a black or dark brown ring. Anterior part of the head, behind the eyes, brown or brown yellowish. Males: central lobe at the apex of the urosternite with a quadrangular depression.

Genitalia. Penis in ventral view truncated at the apex, weakly sinuated, lateral sides convergent to the distal third, after widened slightly to the apex; basal foramen with a very weak medial constriction (Fig. 2b). In lateral view, penis curved in the dorsal region, and straight in the ventral part (Fig. 2c). Spermatheca falciform, with basal ampulla swollen and well differentiated, neck very curved and cornu long; ductus attached to the posterior-superior part of the ampulla (Figs. 2d, 2e).

Distribution. This beetle species was only found in the Granada and Málaga provinces in Andalusia, southern Spain (Vela, 2018). However, here it is also reported from the following sites: Almería, Paterna del Río, 29-VI-1975, 1 ♀, leg. M. Daccordi; Almería, Sierra de Gádor, El Marchal de Antón López, 950m, 27-IV-2011, ♀ on *Quercus* sp., leg. J. Pelikan; Cádiz, Jimena de la Frontera, 500m, 17-V-1998, 1 ♂, 1 ♀, leg. A. Warchałowski (Daccordi's Collection, Verona, Italy).

Host-plants. In the case of the Galerucinae of tribe Luperini, adults feed on the aerial part of the plant while larvae usually feed on the roots. Little is known about the biology of the larval stage of this tribe (Jolivet, 1987). The host-plants formerly identified for *C. foveolatus* adults were *Quercus suber*, *Q. rotundifolia* (Vela & Bastazo, 1999) and *Q. coccifera* (Vela, unpublished data) which are all in the Fagaceae family. The feeding record of *C. foveolatus* on *A. pinsapo* is a newly identified, extraordinary case of allotrophy from Fagaceae to Pinaceae. The two tree families are widely separated phylogenetically, as the *Quercus* species are angiosperms and *A. pinsapo* is a gymnosperm. The early divergent groups of Coleoptera Phytophaga are associated with gymnosperms (cycads and conifers). Such association is considered plesiomorphic within Phytophaga (Farrell, 1998). The diversity of groups of Phytophaga associated with conifers is scarce compared to those associated with angiosperms (Haddad & McKenna, 2016). Possibly, the affinity for gymnosperms found in some genera and species of Chrysomelidae in the subfamily Galerucinae is a secondary adaptation, because Galerucinae is not a basal group in Phytophaga (Nie et al., 2020). Jolivet & Hawskewood (1995) reported several Galerucinae genera

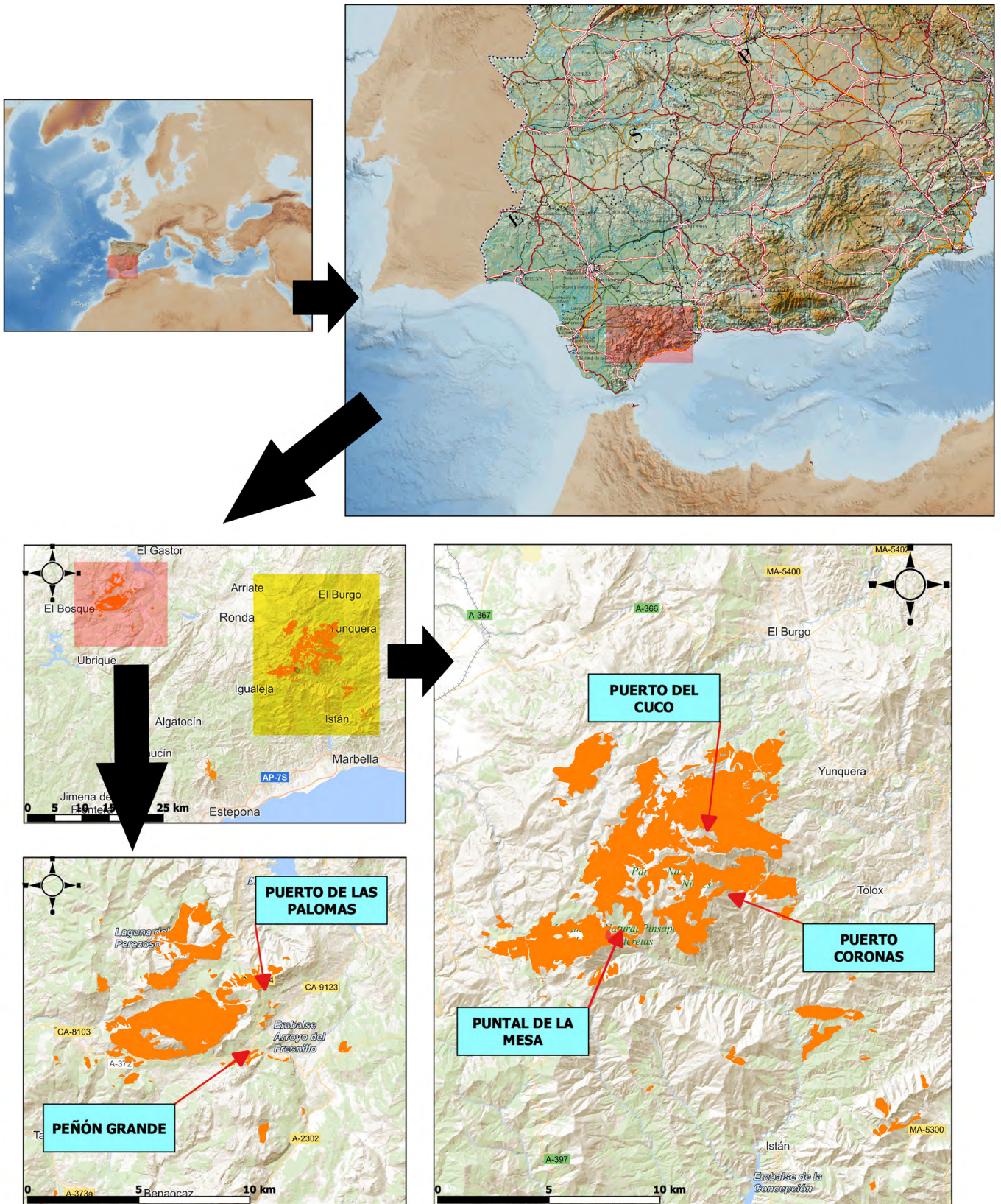


Figure 1. Maps indicating the monitoring area and the sites with pinsapos defoliated by *Calomicrus foveolatus* (blue labels).

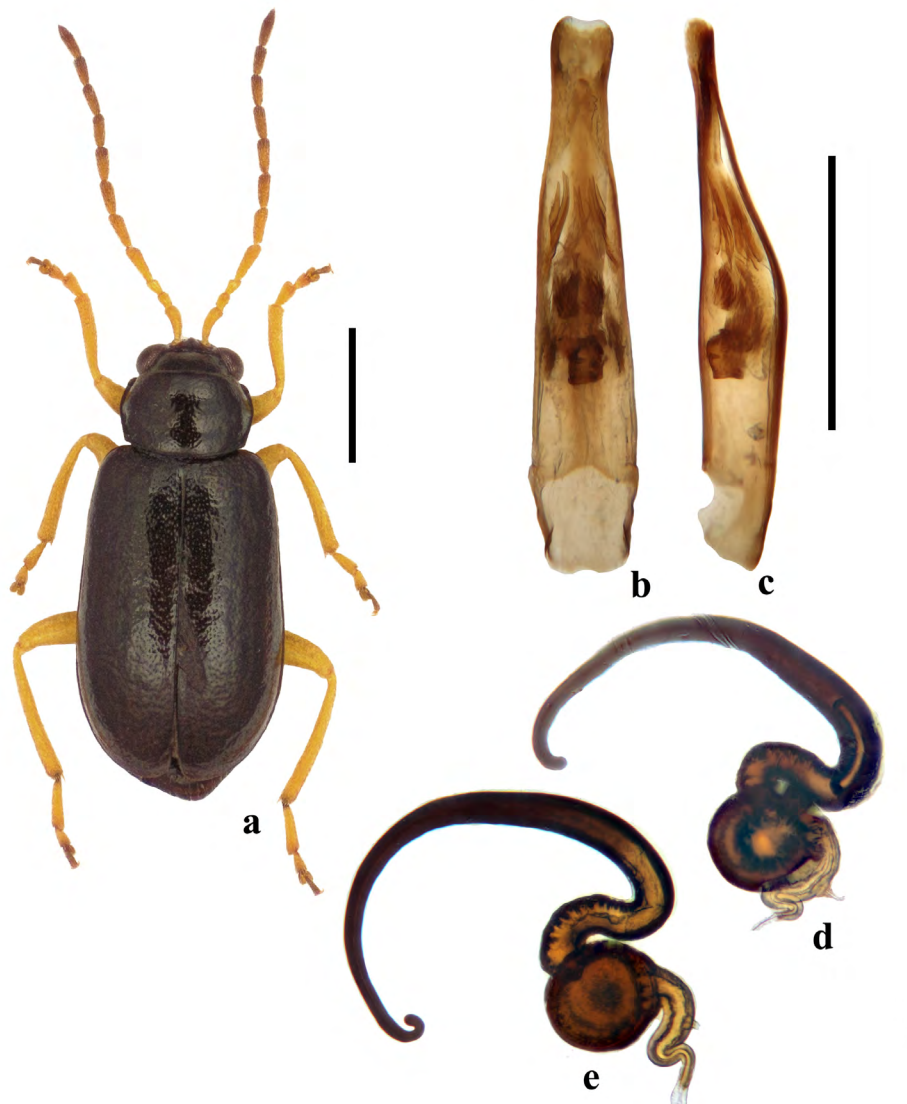


Figure 2. *Calomicrus foveolatus*: habitus (a), aedeagus in ventral (b) and lateral (c) views and variability of the spermatheca (d, e). Scale = 1 mm (a), 0.5 mm (b,c), 0.25 mm (d,e).

such as *Arthrotus* Motschulsky, 1858, *Sphenoraia* Clark, 1865, *Monolepta* Chevrolat, 1836, *Atrachya* Dejean, 1836, *Paleosepharia* Laboissière, 1936, and *Morphosphaera* Baly, 1861, among which one or more species can select gymnosperms as hosts.

A closely related species to *C. foveolatus*, *C. pardoii* Codina, 1961, from the Moroccan Rif and Middle Atlas, was originally described on *Quercus* sp. (Codina, 1961), although it was later reported to cause damage to *Cedrus atlantica* (Endl.) Manetti ex Carrière (Mouna, 1986; Mouna & Avcı, 2016). *Calomicrus apicalis* Demaison, 1891, spread throughout Turkey and Syria, feeds on *Pinus brutia* Ten., *P. nigra* J. F. Arnold, *P. sylvestris* L. and *Cedrus libani* A. Rich. (Gök & Duran, 2004; Gök & Çilbiroğlu, 2005). Moreover, Aytar et al. (2011) found it causing significant damage to the *C. libani* formations in southern Turkey. Another genus closely related to *Calomicrus* is *Euluperus*, which contains three *Pinus* feeding species. *Euluperus pinicola*, from Central

Europe, was reported on *Pinus sylvestris*, *P. nigra* and *P. mugo* Turra (cited as *P. montana* Mill.) (Laboissière, 1934; Müller, 1953; Hiller, 1975). *Calomicrus gularis* Gredler, 1857 (really belonging to *Euluperus* genus), known from Austria, France, Italy, Slovenia and Croatia, was cited on *Pinus mugo* (as *P. montana*) and *P. sylvestris* (Müller, 1953). Finally, *Euluperus espanoli* (Codina, 1963), a Spanish endemism, is also a pine consuming species, reported on *Pinus sylvestris* (Vela, 2018) and *Pinus halepensis* Miller, 1768 (Pérez-Onteniente, 2019). Therefore, there is a tendency in several species of *Calomicrus* and *Euluperus* to feed on species in the Pinaceae family (*Pinus*, *Cedrus* and *Abies*).

Picard (1936), Jolivet (1952) and Jolivet & Petitpierre (1981) used the term allotrophy for the cases where a beetle is found to feed on a host-plant completely unrelated to its normally preferred primary host. This is the case of *Calomicrus foveolatus*. Just as *C. pardoii* became capable of feeding on *Cedrus* in Morocco, *C. foveolatus*



Figure 3. *Calomicrus foveolatus* on *Abies pinsapo*: a couple mating (a), a specimen feeding (b), injured, dry branch (c), damaged trees (d).

changed from *Quercus* sp. (Fagaceae) to *Abies*. Furthermore, the other above-mentioned species appear to only feed on Pinaceae. It is difficult to know what causes the feeding shift from Fagaceae to Pinaceae. The shift could be attributed to the lack of resources provided by *Quercus*, whose growing period has shortened due to water scarcity. Thus, the beetles can benefit from the switch to young branches of Pinaceae.

Field observations of the damage on Andalusian firs

The beetles were observed on *A. pinsapo* in the Puntal de la Mesa area (318388/4059625 ETRS89-30N) of the Parauta Municipal District, in the Sierra de las Nieves National Park, on 28/05/2011, 8/06/2011, 14-21-27/06/2019, 05/06/2020, and 2-9-11/06/2022. In almost all the observations the beetles were mating or feeding (Figs. 3a, 3b). Voucher specimens were collected on 28/05/2011, 21/06/2019, and 5/06/2020.

On the other hand, defoliation due to *C. foveolatus* feeding activity (Fig. 3c) was observed in 2007, 2011, 2014, 2015, 2018, 2019, 2020, 2021 and 2022 in the Puntal de la Mesa (Parauta), in 2011 in the Puerto del Cuco (Yunqueira) and in 2022 in the Puerto Corona (Tolox), in the Sierra de las Nieves National Park (Málaga province), and in Peñón Grande and Puerto de Las Palomas, in the Sierra de Grazalema Natural Park (Cádiz province) (Fig. 1).

Throughout the period of observations, the largest area of damage due to defoliation was detected in 2019 in the Puntal de la Mesa (Parauta, Nat. Park Sierra de las Nieves), where approximately 8 ha were affected. In every other affected spot, the damaged area was only approximately 0.2 ha.

In medium and small firs, *C. foveolatus* specimens prefer the upper half of the crown and needles of the distal part of the shoots on branches facing south and southeast. However, when they appeared in larger adult trees, they were located in the branches of the lower third, extending from there to the rest of the tree. This behaviour could indicate a heliophilic preference. They were found feeding on fir needles of new growing shoots, causing partial and superficial gnawing damage on the upper side of the needles, ultimately causing death of the shoots (Fig. 3d).

The *A. pinsapo* trees are also affected by several other Coleoptera. The most damaging beetle is reported to be the bark beetle *Cryphalus numidicus* Eichhoff, 1878 (Curculionidae). *Anthaxia* (*Anthaxia*) *ceballosi* Escalera, 1931, *Anthaxia* (*Haplanthaxia*) *confusa* Gory, 1841, *Anthaxia* (*Haplanthaxia*) *parallela* Laporte & Gory, 1839, *A. (Melanthaxia) sepulchralis* Fabricius, 1801, *Buprestis flavoangulata* ssp. *baetica* Verdugo, 2005, *B. haemorrhoidalis* Herbst, 1780 (Buprestidae), *Ergates faber* (Linnaeus, 1761), *Hylotrupes bajulus* (L., 1758) (Cerambycidae), *Orthotomicus erosus* (Wollaston, 1857) (cited as *Ips*), *Crypturgus mediterraneus* Eichhoff, 1871,

Cr. numidicus Ferrari, 1867, *Pityophthorus pinsapo* Pfeffer, 1982, *Rhyncolus elongatus* (Gyllenhal, 1827), *Brachytemnus porcatus* (Germar, 1823) (cited as *Rhyncolus*), *Otiorynchus jaenensis* Stierlin, 1873 (Curculionidae), and *Calopus serraticornis* (L., 1758) (Oedemeridae) (Barbey, 1996; Cobos Suárez, 1994; Verdugo, 2005; Valladares, 2009) are other beetles that have been recorded on live or dead parts of pinsapo. Of them, *Anthaxia* (*Haplanthaxia*) *confusa* should be verified, because it normally feeds on Cupresaceae (Verdugo, 2005). All the reported beetles are xylophagous.

Among these beetles, *Pityophthorus pinsapo* and *Anthaxia ceballosi* are endemic to the Baetic Mountains where *Abies pinsapo* is their only host (Plaza, 1983, Verdugo, 2005). However, the whole of the insect fauna associated with pinsapo is an important part of the biodiversity and contributes to the stability of the system, forming part of the trophic food web that also includes vertebrates (Lieutier et al., 2016).

It is worth noting the absence of damage by defoliating insects on pinsapo until now. *C. foveolatus* is the first identified defoliating agent of *A. pinsapo* needles. Monitoring of the beetle populations on pinsapos will be necessary for sustainable management of pinsapo forests.

Data availability: Data and voucher specimens are available upon request to the first author.

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References

- Amaral Franco J do, 1986. Pinaceae. In: Flora ibérica, 1; Castroviejo S et al. (eds.). pp: 165-167. Real Jardín Botánico, CSIC, Madrid. <http://www.floraiberica.org/> [20/06/2023].
- Arista M, 1995. The structure and dynamics of an *Abies pinsapo* forest in southern Spain. For Ecol Manag 74 (1-3): 81-89. [https://doi.org/10.1016/0378-1127\(94\)03507-S](https://doi.org/10.1016/0378-1127(94)03507-S)
- Aytar F, Dağdas S, Duran C, 2011. Biology and control of *Calomicrus apicalis* Demaison, 1891 (Col.: Chrysomelidae), a new pest of *Cedrus libani* A. Rich. in Turkey. Silva Lusit (especial): 33-40.
- Barbey A, 1996. A través de los bosques de pinsapo de Andalucía. [Reedición de: A travers les forêts de pinsapo d'Andalousie, 1931]. Consejería de Medio Ambiente, Junta de Andalucía, Sevilla, 143 pp.
- Cobos Suárez JM, 1994. Estado fitosanitario de los pinsapares andaluces. In: Gestión y conservación de los pinsapares andaluces; Cueto Álvarez de Sotomayor MC, Sánchez García JM (coords.). pp. 35-40. Asociación Forestal Andaluza, Monografías Forestales Andaluzas nº 1, Cádiz.
- Codina Padilla F, 1961. Nota sobre los Luperus marroquíes del subgénero *Calomicrus* Stephens (Col. Chrysomelidae). Graellsia 19: 69-79.
- Farrell BD, 1998. "Inordinate Fondness" explained: Why are there so many beetles? Science 281: 555-559. <https://doi.org/10.1126/science.281.5376.555>
- Gök A, Duran E, 2004. A survey of the subfamily Galerucinae (Coleoptera: Chrysomelidae) of Isparta Province (Turkey), with two new records. J Ent Res Soc 6(2): 15-24.
- Gök A, Çilbiroğlu EG, 2005. Studies on the abundance, biology and harmfulness of leaf beetles (Coleoptera: Chrysomelidae) in natural bush vegetation in Isparta, Turkey. J Pest Sci 78: 13-15. <https://doi.org/10.1007/s10340-004-0061-6>
- Haddad S, McKenna DD, 2016. Phylogeny and evolution of the superfamily Chrysomeloidea (Coleoptera: Cucujiformia). Syst Entomol 41: 697-716. <https://doi.org/10.1111/syen.12179>
- Herrera J, Arista M, Talavera S, 2001. *Abies pinsapo*. In: Libro Rojo de la flora silvestre amenazada de Andalucía. Tomo I: Especies en peligro de extinción. pp. 34-38. Consejería de Medio Ambiente, Junta de Andalucía.
- Hiller E, 1975. Zur Kenntnis des Schwarbraunen Kiefernblattkäfers, *Luperus pinicola* (Dftsch.) (Col., Chrysomelidae). Z Angew Entomol 79: 398-421. <https://doi.org/10.1111/j.1439-0418.1975.tb02363.x>
- Jolivet P, 1952. Allotrophie et Chrysomélides. Nat Belg 33 (3-4): 53-59.
- Jolivet P, 1987. Aperçu de la sélection trophique chez les galerucinae. Étude par genre (Coleoptera Chrysomelidae). Bull Anns Soc R Belge Ent 123: 283-307.
- Jolivet P, Hawkeswood TJ, 1995. Host-plants of Chrysomelidae of the world: an essay about the relationships between the leaf-beetles and their food-plants. Backhuys, Leyden, 281 pp.
- Jolivet P, Petitpierre E, 1981. Biology of Chrysomelidae (Coleoptera). Butll Inst Cat Hist Nat 47 (Sec. Zool. 4): 105-138.
- Laboissière V, 1912. Revision des Galerucini d'Europe et pays limitrophes (suite). Anns Ass Nat Levallois-Perret 18: 13-55.
- Laboissière V, 1934. Galerucinae de la faune française. Ann Soc Entomol Fr 103: 1-108. <https://doi.org/10.1080/21686351.1934.12280236>
- Lieutier F, Mendel Z & Faccoli M, 2016. Bark beetles of mediterranean conifers. In: Insects and diseases of mediterranean forest systems; Paine TD, Lieutier F (eds.). pp. 105-197. Springer, Switzerland, 892 pp. https://doi.org/10.1007/978-3-319-24744-1_6
- López Quintanilla J (ed.), 2013. Los pinsapares en Andalucía (*Abies pinsapo* Boiss.): conservación y sostenibilidad en el siglo XXI. Junta de Andalucía, Sevilla, 574 pp.

- Mouna M, 1986. *Luperus (Calomicrus) pardoi* Codina (Col. Chrysomelidae), ravageur phytophage à l'état adulte du cèdre (*Cedrus atlantica*) au Maroc. Bull Inst Sci Rabat 10: 207-208.
- Mouna M, Avci M, 2016. Cedar forests under threat of new pests. Turk J For 17 (Spec): 71-75. <https://doi.org/10.18182/tjf.75899>
- Müller G, 1953. I coleotteri della Venezia Giulia. Catalogo regionato con tabelle dichotomiche per la classificazione delle specie della regione adriatica orientale, del Veneto e della pianura padana, Vol II: Coleoptera Phytophaga (Cerambycidae, Chrysomelidae, Bruchidae). Centro Sperimentale Agrario e Forestale (pubblicazione n. 4), Trieste, 685 pp.
- Navarro Cerrillo RM, Lara Fernández A, Blanco Oyonarte P, Calzado Martínez C, López Quintanilla J, Fernández Cancio A, et al., 2006. Aproximación a la definición del hábitat fisiográfico del *Abies pinsapo* Boiss. en Andalucía. Invest Agr: Sist Recur For (Fuera de Serie): 137-152. <https://doi.org/10.5424/srf/200615S1-00988>
- Nie RE, Andújar C, Gómez-Rodríguez C, Bai M, Xue HJ, Tang M, et al., 2020. The phylogeny of leaf beetles (Chrysomelidae) inferred from mitochondrial genomes. Syst Entomol 45(1): 188-204. <https://doi.org/10.1111/syen.12387>
- Pérez-Onteniente A, 2019. Nuevos registros de *Calomicrus ibericus* Vela, 2018 y *Euluperus espanoli* (Codina, 1963) (Coleoptera, Chrysomelidae, Galerucinae) en España. Boletín de la SEA 64: 277-278.
- Picard F, 1936. Sur un cas d'allotrophie chez *Galerucella nymphaeae* L. (Col. Chrysomelidae). Bull Soc Entomol Fr 41(3): 45-46. <https://doi.org/10.3406/bsef.1936.14961>
- Plaza E, 1983. Los representantes españoles de las tribus Crypturgini y Pityophthorini (Col., Scolytidae). Eos 59: 223-241.
- Valladares A, 2009. Abetales de *Abies pinsapo* Boiss. In: Bases ecológicas preliminares para la conservación de los tipos de hábitat de interés comunitario en España; Bermejo E, Melado F. (coords.). Dirección General de Medio Natural y Política Forestal, Ministerio de Medio Ambiente y Medio Rural y Marino, 90 pp.
- Vela JM, 2018. On the identity of *Calomicrus fallax* (Joannis, 1865) with description of a new, widespread species of *Calomicrus* from Spain and Portugal and comments on the Iberian species (Coleoptera, Chrysomelidae, Galerucinae). Graellsia 74(2): e074. <https://doi.org/10.3989/graellsia.2018.v74.204>
- Vela JM, Bastazo G, 1999. Ecological and biogeographical aspects of the Andalusian leaf beetles endemisms. In: Advances in Chrysomelidae Biology; Cox ML (ed.). pp. 137-158. Backhuys Publ., Leiden.
- Verdugo A, 2005. Fauna de Buprestidae de la Península Ibérica y Baleares (Coleoptera). Argania editio, Barcelona, 350 pp.
- Warchałowski A, 2010. The Palaearctic Chrysomelidae. Identification keys. 2 vols. Natura Optima Dux Foundation. Warszawa. 1212 pp.